

THE GENUS *EUPHAEA* RAMBUR IN BORNEO

(ODONATA: EUPHAEIDAE)

Descriptions and records of Malesian Odonata, 3^{*)}

The males are the most brilliant of oriental insects, and they are exceeded by none in elegance of form.

Laidlaw 1924: 298

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The genus *Euphaea* Rambur is revised for the species occurring in Borneo. *E. laidlawi* Kimmins of the *tricolor* species group is synonymized with *E. subcostalis* Selys. *Euphaea ameeke* sp. n., a new species of the *impar* species group close to *E. impar* Selys, is described from Brunei. A key to species of *Euphaea* occurring in Borneo is provided, and the distribution of all species is illustrated.

Correspondence: J. van Tol, National Museum of Natural History, P.O. Box 9517, 2300 RA Leiden, The Netherlands.

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The dragonfly fauna of Brunei was virtually unexplored when a few years ago Drs. A. G. Orr and D. J. Thompson started their studies on ecology and behaviour of these insects. A first collection identified by the senior author revealed more than 80 species (Thompson & van Tol in press), including several species new to science. One of these species is described in the present paper.

According to present knowledge there are eight species of Euphaeidae in Borneo, viz. six species of *Euphaea* and two of *Dysphaea*. *Euphaea inaequipar* Selys, reported from Borneo by Selys (1859: sep. 7–8) and Ris (1930), has proved to be a synonym of *Euphaea impar* Selys from Sumatra (Lief tinck 1940). The *Euphaea* species of Borneo are rather poorly known, although adequate material is available in collections worldwide, including the Leiden Museum. One of the reasons is that the species of the complex *tricolor* - *subcostalis* - *laidlawi* - *subnodalis* are very difficult to distinguish. Comparative overviews were first provided by Laidlaw (1920, 1924), followed by Ris (1930) who reviewed the species when he described *E. cora* from the Philippines. In his description of *E. laidlawi*, Kimmins (1936) included sketches of the characteristic seminal vesicles of the first three species mentioned, and Lief tinck (1940) pro-

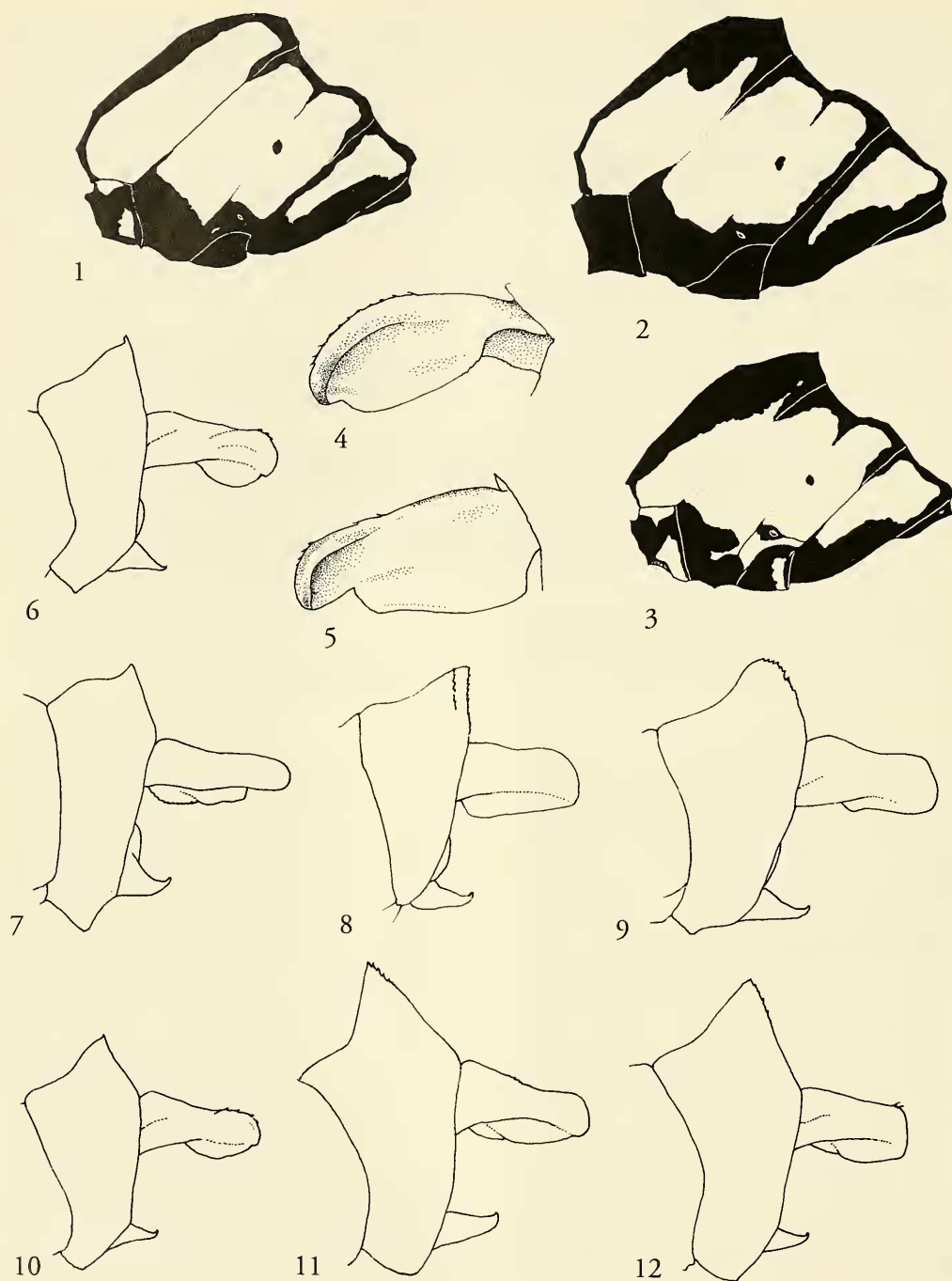
vided the same for *subnodalis*. *Euphaea basalis* seems to be a more distantly related species.

The aim of the present paper is to provide an overview of all species indigenous to Borneo, and to describe their distribution. Since most species have been sufficiently described before, we present a full description for the newly discovered species only, and include short diagnoses for the other species.

Terminology of body parts follows Watson & O'Farrell (1992).

MATERIAL

We have examined the specimens kept in the Leiden Museum (RMNH), consisting of series of all species known from Borneo and collected in most parts of that island. From eastern Kalimantan there are large series taken by M. E. Walsh-Held, while L. Coomans de Ruiter collected extensively in the western part of the island. Both collectors were active during the 1930's. A smaller collection was made in the central part of present-day Kalimantan, mainly taken by Nieuwenhuis in the 1890's. Collections from the non-Indonesian part of Borneo are from Mt. Merapok (Dent province, former British North Borneo, collected at the end of the 19th century; this



Figs. 1-12. *Euphaea* species, males. – 1, *E. ameeke* sp. n., thorax in lateral view. Brunei (JvT 8363); 2, *E. cora*, same. Samar Is., Philippines; 3, *E. impar*, same. Kalimantan (JvT 8362); 4, *E. ameeke* sp. n., inner view of superior anal appendage (JvT 5016); 5, *E. cora*, same; 6-12, last abdominal segment and anal appendages, left lateral view, 6, *E. ameeke* (JvT 5016); 7, *E. cora*; 8, *E. subcostalis* (JvT 8737); 9, *E. basalis* (JvT 8733); 10, *E. impar* (JvT 8968); 11, *E. subnodalis*; 12, *E. tricolor* (JvT 8802).

locality can be found on map 67 of Anonymus 1905, see also Anonymus 1925/1926) (this locality is presumably identical to Gn. Lumaku; Merapok is now a village in the extreme NW corner of Sarawak, just at the border with Sabah), from Sabah (Kinabalu area, east and southern Sabah, among others collected by the senior author), from Sarawak (leg. M. A. Lief tinck), and finally recent collections from Brunei, brought together by Drs. A. G. Orr and D. J. Thompson. Apart from these series, we were also able to study single specimens of series kept in other institutions, obtained in exchange for the Leiden Museum by M. A. Lief tinck.

SYSTEMATIC PART

Key to the males of *Euphaea* of Borneo

Keys to the *Euphaea* species of Borneo have been published by Laidlaw (1920, 1924) and Ris (1930). The present key includes some features not used in those keys, and the new species described in this paper. The males of all Bornean species of *Euphaea* have a hyaline fore wing. The genus *Dysphaea* is characterised by the nodus situated at the middle of the wing (basal to nodus in *Euphaea*), and a smoothly rounded dorsum of abdominal segment 10 (with dorsal projection in *Euphaea*). The superior anal appendages are stronger curved inward in *Dysphaea* than in *Euphaea*. The females are more difficult to distinguish, and are not further discussed here.

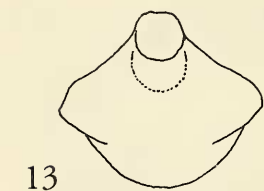
1. Brown opaque area of hind wing at least from nodus to tip of wing (in some species area basal to nodus also opaque to some extent); basal part of opaque area with distinct metallic blue shine; thorax brownish black (in life with greenish tinge), sometimes with some slight yellowish longitudinal markings along the sutures; seminal vesicle usually, but not in all species, with sharp lateral projections, and posterior side broadly rounded (figs. 13-28) 2
- Brown opaque area of hind wing confined to apical one-third, starting approximately halfway between nodus and pterostigma, without conspicuous metallic shine, or hind wing fully hyaline; thorax matt black with extensive blue lateral markings; vesicle rounded laterally and posteriorly with a more or less conspicuous acute tip (figs. 29-33) 5
2. Hind wing fully opaque, brown, vesicle rounded (figs. 25-26). Large species, hind wing 27-28 mm. Mt. Kinabalu only *E. basalis*
- Base of hind wing hyaline at least to Ax 10 3
3. 'Auricles' of tergite 2 pale yellowish on dorsal surface, or at least much paler than rest of tergite 2; opaque area of hind wing starting usually at or

- just basal to nodus, subcostal space hyaline at least in basal part; seminal vesicle rounded (figs. 27-28). Size variable, with hind wing 25-28 mm. West, central and northern Borneo, but not in the Kinabalu region *E. tricolor*
- 'Auricles' on dorsal surface brownish black, concolorous with rest of tergite 2; opaque area of hind wing distal to Ax 10-15 rather than distal to nodus or just basal to it; lateral projections of vesicle acute 4
 - 4. Larger species with hind wing more than 26 mm; radial space in hind wing hyaline to nodus; vesicle with lateral projections long and sharp (figs. 23-24); 'auricles' long and slender. Northwestern Borneo *E. subnodalis*
 - Smaller, but very variable species, hind wing 22-24 mm; radial space of hind wing opaque from same level as rest of opaque distal part; vesicle very variable from broadly rounded and flat ('*laidlawi*') (figs. 13-14) to broadly transverse with long acute lateral sides ('*subcostalis*') (figs. 21-22); 'auricles' more or less triangular and usually shorter than vesicle in lateral view *E. subcostalis*
 - 5. Distal one-third to two-fifths of hind wing opaque, brown without metallic blue shine; labrum, mandible and gena with distinct blue and creamish blue markings *E. impar*
 - Hind wing hyaline; labrum, mandible and gena without, or with very faint, pale markings *E. ameeke* sp. n.

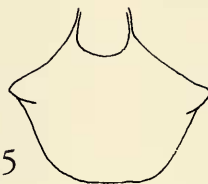
The *Euphaea tricolor* group

The *Euphaea tricolor* group, as defined by Ris (1930) consists of *tricolor*, *subcostalis*, *subnodalis*, *amphicyana* and *basalis*. Later, Kimmins (1936) added *Euphaea laidlawi* to this group of species. All species of this group, except *amphicyana* from Mindanao, are endemic to Borneo. The status and distribution of the Bornean species of *Euphaea* has not been discussed since Lief tinck (1940: 343-344, fig. 2) commented upon *E. subnodalis*.

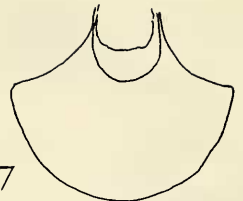
The *Euphaea tricolor* group superficially represents a homogeneous group of species, of which Laidlaw (1924) presumes a close relationship to the *masoni* group of mainland southeast Asia. On closer examination, two species are obviously distinct, viz. *basalis* and *tricolor* (see key, and diagnoses below), but the other three nominal species are closely related indeed. *Subnodalis*, however, seems to be definable on its large size, and the shape of the opaque area in the hind wing. The seminal vesicle of specimens with this combination of characters is also without variation, but this shape, although of smaller size, also occurs in *subcostalis*. We have been unable to find any charac-



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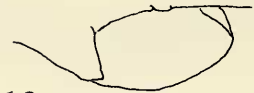
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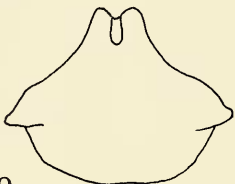
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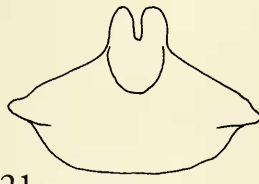
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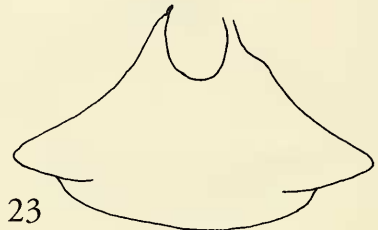
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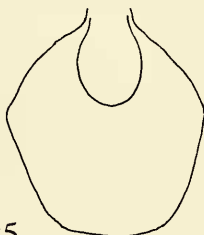
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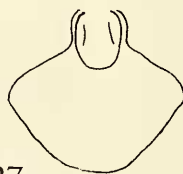
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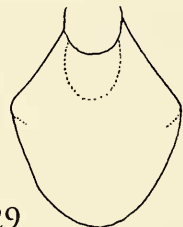
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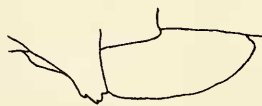
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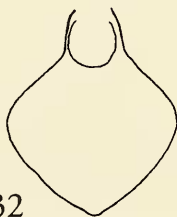
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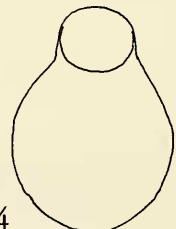
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ters that can unambiguously delimit a subdivision among the rest of the specimens of the *tricolor* group. Both the shape of the opaque area in the hind wing, and the shape of the seminal vesicle, appeared to be most variable. The shape of the vesicle, although frequently considered of taxonomic importance, is also very variable in both species of the *E. impar* group discussed below. Consequently, *subcostalis* and *laidlawi* are here considered to represent only extremes of a very variable species. Since the variation seems have a geographical component, we cannot exclude that microspecies within this complex can be distinguished when more material becomes available with intermediate forms only occurring in narrow zones. Actually, *laidlawi* specimens may represent such hybrids between 'typical' *subcostalis* and *subnodalis*. We suggest a further study of the geographical variation of this group in Borneo, based on an extensive sampling program throughout Borneo, but particularly in the northwestern part of the island.

Euphaea basalis (Laidlaw)

(figs. 9, 25-26, 36)

Pseudophaea basalis Laidlaw, 1915: 32 (type locality Kina Balu).

Pseudophaea basalis. – Laidlaw 1920: 326-327 (Kinabalu); Laidlaw 1924: 298 (key); Kimmins 1969: 306 (holotype ♂).

Euphaea basalis. – Ris 1930: 88-89 (characters); Laidlaw 1931: 241; Laidlaw 1934: 550; Schmidt 1934: plate 17 (1) (pair of wings); Lieftinck 1954: 16 (distribution); Asahina et al. 1983: fig. 39 (pair of wings).

Diagnosis. – Hind wing dark without basal hyaline area, blue metallic in basal ca. 16 mm; costal, subcostal and cubital space, and quadrangle black. Semical vesicle round and rather flat, in lateral view hardly reaching beyond 'auricle' (figs. 25-26); length 1.2 mm. Superior anal appendage (fig. 9) relatively slender with inner ventral scoop-like tubercle visible in distal three-fifths in lateral view.

Hind wing 27-29 mm.

Female unknown.

Distribution. – Only known from Mt. Kinabalu (1000-1500 m) (fig. 36). Apparently occurring at low densities only.

Material examined (RMNH). – 4 ♂, all from Sabah, Kinabalu Mt. (Marai Parai, Tahuban river, Silau Silau river, Liwagu river) (all in RMNH).

Figs. 13-34. Seminal vesicles of male *Euphaea* species in ventral and lateral view. – 13-22, *E. subcostalis*. 13-14, Sarawak, Lawas, paratype of *E. laidlawi* (JvT 9043); 15-16, Mt. Marapok (JvT 8775); 17-18, Sabah, Kinabalu area, Kamadaian river (JvT 9153); 19-20, Sarawak, Merirai valley (JvT 8777); 21-22, Sabah, Danum valley, (JvT 8747); 23-24, *E. subnodalis*, Sabah, Long Pasia, Maga river (JvT 8750); 25-26, *E. basalis*, Sabah, Kinabalu Park, Liwagu river (JvT 8735); 27-28, *E. tricolor*, Borneo, Kalimantan, Singkawang (JvT 9052); 29-30, *E. ameeke* sp. n., Brunei (JvT 8375); 31, idem, ventral view only (JvT 8376); 32, *E. impar*, Kalimantan, Bautau Bessi (JvT 8977); 33, same species and locality (JvT 8978); 34, *E. cora*, Samar Is.

Euphaea subcostalis Selys

(figs. 10, 13-22, 37)

Euphaea subcostalis Selys, 1873: 483 (sep. 19) (original description, type locality Labuan).

Pseudophaea subcostalis. – Laidlaw 1915: 32-33 (record Kina Balu); Laidlaw 1920: 326 (records Tampassuh, Sarabas, Mt. Murud, Ulu Akar).

Euphaea subcostalis. – Laidlaw 1931: 241 (Borneo); Schmidt 1934: plate 17 (3) (pair of wings); Lieftinck 1954: 18 (references, distribution); Asahina 1983, fig. 39 (pair of wings).

Euphaea laidlawi Kimmins, 1936: 77-78, figs. (original description, type locality Sarawak, Palawan). – Lieftinck 1954: 17 (references, distribution); Kimmins 1969: 307 (holotype ♂ BMNH [= lectotype]). **Syn. n.**

Diagnosis. – Hind wing rather short and broad, with opaque area distal to ca. Ax 12-15, with metallic blue area extending to Px 6-8, distal margin oblique to Costa; costal space hyaline up to level of Ax 12-15, but subcostal space brown. Seminal vesicle very variable, see below. Anal appendages with superiors (fig. 10) rather robust, with scoop-like ventral inner tubercle virtually extending from base to tip in lateral view.

Variation. – Kimmins (1936: 77-78) described *E. laidlawi* based on two males collected by Everett at Lawas in 1896. A specimen with the same locality and collector is kept in the Leiden Museum, but it is not certain that this represents the para(lecto)type. The specimen fits the description exactly, including the low profile of the vesicle in lateral view (figs. 13-14). Such specimens have not been found on any other locality in Borneo. On the other hand, all kinds of intermediates in the shape of the vesicle between this form and the 'genuine' *subcostalis* can be found (figs. 15-22). The coloration of the wing and the shape of tergite 10, is, as far as we can see, also very variable and of no value for distinguishing taxa.

Distribution. – Widespread in lowland Borneo, but rather scarce in NW part of Sabah, where it is found only at lower altitudes of Mt. Kinabalu and mountain ranges extending southward. At higher altitudes it is replaced by *E. subnodalis*. Forms previously considered as *E. laidlawi* are mainly from the coastal region of NW Borneo (southern Sabah, Sarawak and Brunei). *E. subcostalis* is especially common in streams through lowland rain forest, where it has not been recorded above 600 m. The males can be found perching in high densities in sunny patches along rivulets running through canopy gaps. Kimmins (1936) men-

tions habitat segregation with *E. tricolor*. This observation is confirmed by Dr. A. G. Orr (pers. comm.) 'At Kuala Belalong Field Studies Centre *E. tricolor* is restricted to the main stream of the Sg. Belalong, and is abundant. *E. subcostalis* is restricted to small side tributaries and is also very abundant. The two may occasionally interact at the mouths of such tributaries'.

Material examined (RMNH). – 101 specimens from Sabah (Gn Marapok, Kamadaian river, Quioin Hill, Kalabakan, Danum Valley), Sarawak (Akar river, Kapit, Matang, Lawas), Brunei (Belalong) and Kalimantan (Midden Oost Borneo Expeditie, Batau Bessi, Kariorang, Nunukan, Bengen river). The type locality (Labuan) is not indicated on the map. This island off the northwest coast of Borneo was an important trading centre during the 19th century, and useless as an indication of the actual sampling station.

***Euphaea subnodalis* (Laidlaw)**
(figs. 11, 23-24, 38)

Pseudophaea subnodalis Laidlaw, 1915: 31-32 (type locality Mt. Kinabalu).

Pseudophaea subnodalis. – Laidlaw 1930: 326 (Kina Balu); Kimmins 1969: 307 (holotype ♂ BMNH).

Euphaea subnodalis. – Ris 1930: 88-89 (key, distribution); Schmidt 1934: plate 17 (4) (pair of wings); Lieftinck 1940: 343-344, fig. 2 (references, material, compared with *subcostalis* and *laidlawi*, anal appendages); Lieftinck 1954: 18 (references, distribution); Asahina et al 1983: fig. 39 (pair of wings).

Diagnosis. – Very similar to *subcostalis*, but larger and with hind wings relatively narrower. Hind wing with opaque dark coloration distal to Ax 10-15, but costal and radial space hyaline between base of wing and nodus; metallic blue (or blue-green) basal area extending to Px 10, running only somewhat oblique to Costa. Length of hind wing 26-28 mm. Seminal vesicle 1.1 mm, and profile usually considerably higher than in *subcostalis*, posteriorly broadly rounded and lateral projections more or less acute and expanded. 'Auricle' considerably longer and narrower than in *subcostalis*, reaching beyond the vesicle in lateral view (figs. 23-24). Last abdominal segment remarkably elevated. Anal superior appendages with ventral tubercle of more complex nature than in *subcostalis*, with a transversal ridge running near base (see also *tricolor*) (fig. 11).

Distribution and biology. – NW Borneo (Sabah) above 1000 m (fig. 38). This species seems to inhabit larger streams at higher altitudes than *E. subcostalis* s.l. It was apparently formerly common around 1000 m on Mt. Kinabalu, but the population density seems to be much lower today, possibly due to the heavy pressure of urban settlements on river systems below 1500

m. In the southernmost part of Sabah, close to the borders of Sarawak and Kalimantan, this species was common at ca. 1000 m altitude in 1987, when this area was still covered with virtually undisturbed submontane rain forest. It occurs sympatrically with *E. tricolor* in that area, with *tricolor* at much lower densities.

Material examined (all RMNH). – 33 specimens from Sabah (Kinabalu, Gn. Marapok, and various rivers around Long Pasia).

***Euphaea tricolor* Selys**
(figs. 12, 27-28, 39)

Euphaea tricolor Selys, 1859: sep. 8 (original description, type locality Saratoga [= lapsus pro Sarawak]).

Pseudophaea tricolor. – Laidlaw 1920: 326 (records Retuh, Saribas, Baram).

Euphaea tricolor. – Laidlaw 1931: 241 (Borneo); Schmidt 1934: plate 17 (2) (pair of wings); Lieftinck 1954: 18; Asahina et al. 1983: fig. 39 (pair of wings).

Diagnosis. – Hind wing with opaque area distal to nodus; blue metallic area from nodus to Ax 12 with distal margin somewhat oblique. 'Auricles' pale coloured on dorsal surface. Seminal vesicle more or less diamond-shaped with rounded lateral sides (figs. 27-28). Anal appendages with superiors relatively short with tip distinctly squarish; in lateral view superior appendage is broader terminally than basally.

Distribution and biology. – Widespread in western and central Borneo, but possibly lacking in the Kinabalu region and certainly absent from Southeast Borneo (fig. 39).

Material examined (RMNH). – 27 specimens from Sabah (Gn. Marapok, Padas river), Sarawak (Dingey river, Tebang), Brunei (Belalong), Kalimantan (Mahakkam, Bloc-oe, Penaring, Bengkajang).

The *Euphaea impar* group

The group of *Euphaea impar* consists of three species, viz. *E. impar*, *E. cora* and *E. ameeke* sp. n. Ris (1930) considered *E. inaequipar* as a distinct species, but Lieftinck (1940) synonymized both taxa. *E. cora* has been recorded from the Philippine islands (Mindanao, Samar) and is not further discussed here (but see figs. 2, 7 and 34). It seems to be a rather rare species (M. Hämäläinen, personal comm.). We were able to study a male and female from Samar from the collection of Dr. Hämäläinen. In the Leiden Museum there are two female specimens from the Philippine Islands (Basilan I., leg. Baker (ex UMMZ, no 2448-1920), and Tobedo, 300 m, 15 May 1951, leg. H. Townes) [locality not found].

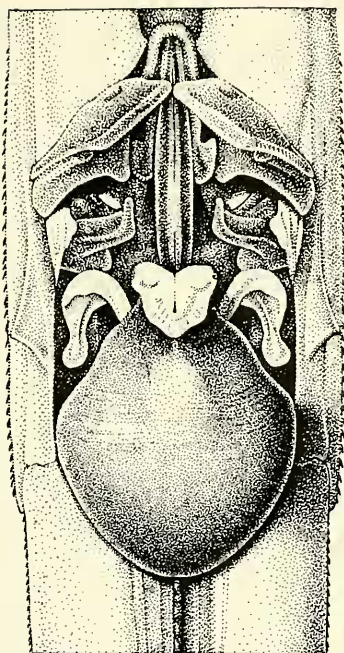
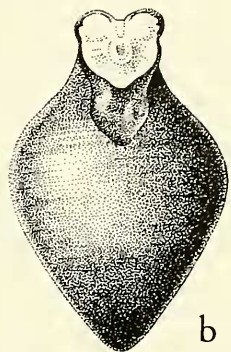


Fig. 35. *Euphaea ameeke* sp. n. Secondary genitalia in ventral view. (a) with seminal vesicle round (JvT 8375), and more elongate (JvT 8376).



a

b

1 mm

***Euphaea ameeke* sp. n.**
(figs. 1, 6, 29-30, 40)

Type material. – Holotype ♂, 'BRUNEI Darussalam. Surroundings Ingai base camp along Ingai river. Stream in freshwater swamp forest running into S. Ingai, 20 min. walk S of base camp. 4°09'21"N 114°42'56"E. 12 Sep 1992. D. Thompson' (in RMNH) [no 12/9/11] [JvT 4888]. – Paratypes 14♂ 1♀ (all Brunei Darussalam): Ulu Belai, between Ingai and Topi rivers, c. 4°08'N 114°43'E, 3 Oct 1992, 1♂ (D. Thompson) [JvT 5016] in RMNH; Bkt Teraja, 9 Sep 1993, 2♂ (A. G. Orr) [JvT 8363/8364] in RMNH; Belait district, Sg. Mendaram, Sep. 1993, 2♂ (A.G. Orr) in RMNH [JvT 8374/8375]; Menteripools, 28 Oct 1993, 1♂ (A.G. Orr) in RMNH [JvT 8376]; Belait district, near Labi, Sg. Mendaram, 3 Feb. 1995, 8♂ 1♀ (A. G. Orr) in RMNH [JvT 9792/9800].

Description

Male holotype. – Head. Labium in ventral view with base pale coloured, the central part suffused with brown; lateral lobe and movable hook brownish black except for the pale base of lobe, median lobe glossy brownish black with central part pruinose, median cleft reaching to two-fifth the height of median lobe; maxilla as far as visible in ventral view pale; labrum,

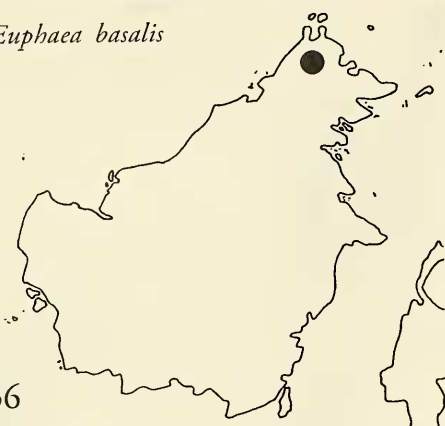
mandibles and clypeus glossy brownish black; remaining part of head matt black without any pale markings.

Thorax. Prothorax matt black with a paired elongate transversal marking on middle lobe. Synthorax (fig. 1) matt black with extensive bright blue (pale blue in preserved material) coloration covering most parts; dorsal carina with anterior triangle and antealar region black, mesepisternum blue except for narrow line against mesopleural (=humeral) suture and pre-alar ridge and posteriormost part of mesopleural suture; mesokatepisternum (= mesinfraepisternum) brownish black with a small blue spot against mesepisternum, and a pale creamish spot near lower side of mesepimeron; metepisternum above interpleural suture blue, anteriorly leaving only one-fifth black, metepisternum below interpleural suture black leaving anterior part up to and inclusive the stigma black, a small black spot against interpleural suture circa half-way the blue area; metepimeron black with an elongate blue marking on upper half from anterior one-fourth to hind margin, the marking widening at posterior end and extending along hind margin of metepimeron.

Legs black. Wings with veins black, an indistinct yellowish brown lustre; fore and hind wing transparent without any opaque black marking; fore wings with 18-19 Ax, 24-26 Px; hind wing with 17 Ax, 20-

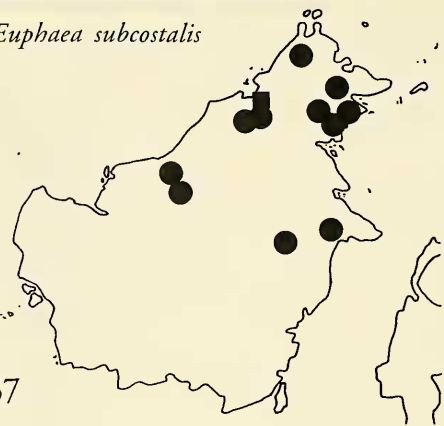
Euphaea basalis

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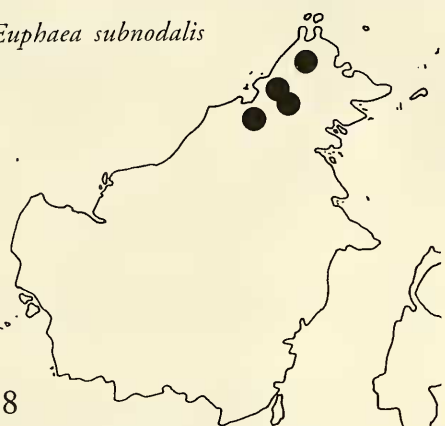
Euphaea subcostalis

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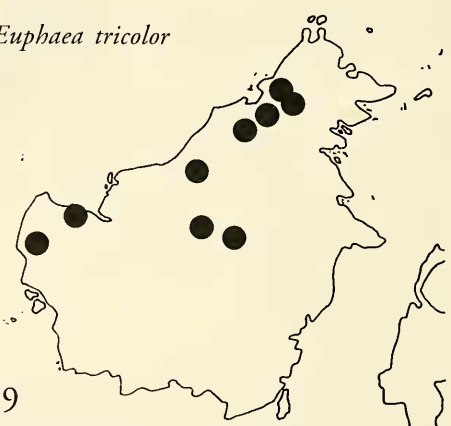
Euphaea subnodalis

38



Euphaea tricolor

39



40

21 Px; discoidal cell in all wings with one cross-vein; 2-3 Cux; origin of R3 $2\frac{1}{2}$ -3 cells distal to subnodus; pterostigma dark brown, covering 7-8 cells.

Abdomen. Fully matt black except for a paired subquadrangular blue spot lateral on tergite 1, covering circa $\frac{3}{5}$ of segment length, and a very inconspicuous longitudinal line on both sides of segment 2; segment 10 with distal half triangularly raised into a dorsal projection. Seminal vesicle variable, from broadly rounded (fig. 35a) to more elongate, posteriorly acute. Appendages with superior (fig. 6) in distal half with smoothly rounded ventral tubercle.

Measurements. Hind wing 25 mm, abdomen incl. appendages 32 mm.

Female (paratype JvT 9800). – Pale coloration darker than in male, dirty yellow (in life dark olive green).

Head. Labium including lateral lobes yellowish white, with only tips of middle lobe and movable hooks glossy black; labrum glossy brownish black with a paired subtriangular yellowish white spot, each covering the lateral third, but leaving narrow black anterior and lateral borders; mandibles glossy yellowish white with a brownish black border dorsally and anteriorly; clypeus brownish black; remaining part of head matt black, except yellowish white gena, more or less extending above clypeus, and an elongate pale marking between lateral ocellus and antenna.

Thorax. Prothorax matt black, but middle lobe with triangular dirty yellow markings laterally and lateral tubercle dirty greyish yellow. Synthorax mostly blueish or dirty yellow; mesepisternum blueish, but leaving black borders against dorsal carina, hind margin and dorsal one-fourth over mesopleural suture; also a darker central line over dorsal two-thirds of mesepisternum; rest of synthorax mostly pale coloured, but dark patches over dorsal part of interpleural and metapleural sutures, a subquadrangular marking on mesokatepisternum, and metepimeron brown in central part. Wings hyaline, with 19-21 Ax and 20-22 Ax in fore wing, and 15-16 Ax and 19-20 Px in hind wing.

Abdomen. Brown, darker on dorsal side, but segment 1 on lateral side with pale triangular marking pointed anteriorly, widening posteriorly and emarginated on dorsal side; segment 2 with yellow lateral line, segment 3-7 latero-anteriorly with triangular pale marking, relatively large on segment 3 and smaller on each following segment; these segments followed by a longitudinal line on segments 3-5, wider on 3 than on on following segments; lateral lines on

all segments posteriorly ending against transversal suture.

Measurements: hind wing 24 mm, abdomen 25 mm.

Remarks

Variation. – Males. There is hardly any variation in the coloration of the paratypes. Wing venation is as follows: fore wing with 18-21 Ax and 23-26 Px; hind wing with 15-18 Ax and 19-24 Px.

The shape of the seminal vesicle is variable as in *E. impar*: in some specimens it has a distinctly elongate shape, while in others it is more or less round (fig. 35). Hind wing 24-25 mm, abdomen incl. appendages 29-31 mm.

Differential diagnosis. – Apparently a close relative of *Euphaea impar*. Both species are structurally similar, but differ in the shape of the wing. The coloration of male head and thorax differs in most characters rather subtly. However, the shape of the blue markings on the mesepisternum (cf figs. 1 and 3), and the absence of any opaque dark markings in the hind wing of *Euphaea ameeke* are distinctive. The blue and creamish markings on the head of *E. impar* are hardly visible in *ameeka*. The female is very similar to the *E. impar*, including the markings on the head, but the central black line over labrum is very narrow in *E. impar*. Dorsal half of mesepisternum brownish black in *E. impar*, and with extensive dark olive green markings in *E. ameeke*. Pale lateral lines wider and extending to segment 7 (rather than to 5) in *E. impar*. *E. ameeke* is also a close relative of another species of the *Euphaea impar* group as defined by Ris (1930), viz. *E. cora* Ris. Since this species also has fully hyaline wings, the general appearance is very similar. The structure of the male superior anal appendages of *E. cora* (fig. 5), however, differs distinctly from both *E. impar* and *E. ameeke* (fig. 4).

Although we have not found any structural genital characters, *E. impar* and *E. ameeke* are considered distinct species, since they occur sympatrically in Brunei. In that region these species show habitat segregation in the upper courses of streams in Brunei forests (A. G. Orr, pers. comm.). Despite their sympatric occurrence, no intermediates have been noticed. Specific isolation of calopterygoids is, as far as known, especially enforced during the pre-mating phase of reproductive behaviour. Isolation during copulation, e.g. by differences in the shape of the secondary genitalia, is less common. It is generally only observable between distantly related species. This phenomenon

Figs. 36-40. Distribution patterns of *Euphaea* species occurring on Borneo. All species except *E. impar* are endemic to Borneo. Based on collection of RMNH Leiden and published records. – 36, *E. basalis*; 37, *E. subcostalis*, the square is the type locality of *E. laidlawi*; 38, *E. subnodalis*; 39, *E. tricolor*; 40, *E. impar* (circle) and *E. ameeke* sp. n. (square).

is also known in the Calopterygidae and Chlorocyphidae. For instance, morphological differences between the two European species of *Calopteryx*, *C. virgo* (L.) and *C. splendens* (Harris), are nearly absent, while hybrids have never been documented.

A comparative study of the reproductive behaviour of *E. impar* and *E. ameeke* would provide an excellent opportunity to contribute to our understanding of the speciation processes of the euphaeids.

Etymology. – Named after daughter Ameeka of the first collector of this species, Dr. D. J. Thompson. A noun in apposition.

Distribution. – Brunei (fig. 40).

Euphaea impar Selys (figs. 3, 8, 32-33, 40)

Selected references

Euphaea impar Selys, 1859: sep. 7 [type locality Mt. Ophir, Malacca].

Euphaea impar. – Laidlaw 1902: 87 (record Aring river, Peninsular Malaysia); Ris 1930: 85-86 (key); Lieftinck 1940: 341-343 (synonymy, references, material); Lieftinck 1954: 16-17 (references, synonymy, habitat, distribution Malaya, Anambas, Sumatra, Bangka, Borneo); Asahina et al. 1983, fig. 39 (pair of wings); Asahina 1993: 5 (record Thailand); Thompson & van Tol 1995 (records Brunei).

Euphaea inaequipar Selys, 1859: sep. 7 [type locality Saratoga [= lapsus pro Sarawak]].

Euphaea inaequipar. – Ris 1930: 86 (key); Lieftinck 1940: 342 (status discussed).

Diagnosis. – Head with significantly more blue coloration than in *E. ameeke*. Labrum dark brown with a large central blue marking, leaving only narrow dark margins on all sides, blue marking medially transversed by a dark stripe, which is widest in the middle; mandibles pale blue with anterior and basal side dark, clypeus glossy brownish black; remaining part of head matt black, except for blue coloured genae below antennae.

Thorax. Prothorax mainly matt black, middle lobe without blue markings. Synthorax mainly blue coloured, although blue markings are less extensive than in *E. ameeke*. Mesepisternum only blue in anterior lower third (fig. 3), remaining part matt black. Wings with fore wing hyaline, base of hind wing hyaline, opaque brown marking in hind wing from Px 12 to tip of wing.

Abdomen. Brownish black to black. Shape of seminal vesicle as variable as in *E. ameeke* (fig. 32). Anal appendages with distal half of superior smoothly rounded ventral tubercle (fig. 10).

Measurements. Hind wing c. 25 mm, abdomen incl. appendages c. 31 mm.

Geographical variation. – Specimens from Sumatra

are similar in structure and markings to those from Borneo.

Distribution. – Thailand, Peninsular Malaysia, Sumatra, Borneo.

Material examined (all RMNH). – 214 specimens from Sabah (Gn Marapok), Brunei (Ingai river), Kalimantan (Katoergau Mts, Raja Mts, Bengkajang, Bagak river, Penaring, Poteng Mts, Batau Bessi, Kariorang, Maloewi, Ampah, Santubang, Gunungsari, Bengen river), Sumatra (Tanggamoos Mts, Deli Laut Tador), Bangka Island and West Malaysia (Penang Island, Kledang Mts, Templer Park, Mupor river).

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